



Surgical Experience with a Microscopic Transsphenoidal Approach to Pituitary Tumors and Non-Neoplastic Parasellar Conditions

CHARLES B. WILSON, M.D., *San Francisco*, ROBERT W. RAND, M.D., PH.D.,
Los Angeles, JOHN M. GROLLMUS, M.D., *San Francisco*,
GUNNAR HEUSER, M.D., PH.D., *Los Angeles*, SEYMOUR LEVIN, M.D.,
EDYTHE GOLDFIELD, M.D., AND VICTOR SCHNEIDER, M.D., *San Francisco*,
JOHN LINFOOT, M.D., *Berkeley*, AND YOSHIO HOSOBUCHI, M.D.,
San Francisco

■ *Improved surgical microscopes and intraoperative radiofluoroscopic television have revived the transsphenoidal approach to pituitary tumors. The transsphenoidal approach offers an alternative to craniotomy, and in certain situations it has distinct advantages. The reported experience includes the common pituitary tumors, hypersecreting microadenomas, cerebrospinal rhinorrhea and parasellar aneurysms. The surgical technique, indications and contraindications, and results in 44 transsphenoidal operations are described.*

A REVIVED INTEREST in transsphenoidal operations has evolved with the introduction of present-day surgical microscopes, brilliant illumination and ocular magnification invalidating earlier objections to the limited visibility provided by this exposure. With the more recent addition of intra-operative televised radiofluoroscopic control, the transsphenoidal approach to certain condi-

tions in and adjacent to the sella turcica has distinct advantages over treatment of the same conditions by craniotomy.

This communication provides a brief historical review of the procedure, describes our transsphenoidal approach to the sellar region and details our experience with transsphenoidal operations in a series of 44 patients.

The Evolution of the Transsphenoidal Approach

The transsphenoidal extracranial approach to the pituitary initiated by Koenig in 1898¹ involved splitting and retracting of the superior maxilla. Shortly thereafter, Giordana suggested a more superior approach with an osteoplastic

From the Department of Neurological Surgery (Drs. Wilson, Grollmus and Hosobuchi) and the Metabolic Unit for Research in Arthritis and Allied Diseases (Drs. Levin, Goldfield and Schneider), University of California School of Medicine, San Francisco, California; the Department of Radiology, Alta Bates Hospital and Donner Laboratory, Berkeley, California (Dr. Linfoot), and the Department of Surgery, University of California School of Medicine, Los Angeles, California (Drs. Rand and Heuser).

Submitted May 19, 1972.

Supported in part by Clinical Cancer Research Grant PHS 5-PO2-Ca 11067, NIH Training Grant NS 5593, and General Clinical Research Center Grant USPHS RR-79.

Reprint requests to: C. B. Wilson, M.D., Department of Neurological Surgery, University of California School of Medicine, San Francisco, Ca. 94122.

resection of the nose and anterior wall of the frontal sinus, reaching the sphenoid sinus through the ethmoids. In 1907, Schloffer used this method for the first successful removal of a pituitary tumor. Use of Giordana's approach spread rapidly despite the disfigurement entailed, the operative morbidity, and the frequency of infection.

Kanavel² observed that the majority of pituitary tumors grew downward, eroding the sellar floor and thereby making the transsphenoidal route preferable to open craniotomy. He abandoned the earlier extensive and multi-staged procedures and advocated elevation of the nose and a direct approach through the sphenoid sinus. Others^{3,1} introduced modifications of Kanavel's method, but credit for refining the transsphenoidal approach goes to an otolaryngologist, Oscar Hirsch.⁴⁻⁷

Cushing⁸ adopted the transsphenoidal procedure and, by 1914, he had performed 74 operations on 68 patients. Equally skillful in approaching the sella turcica from above (by frontal craniotomy) and below (by the transsphenoidal route), Cushing stated, "It is certain that no one method is applicable for all conditions of pituitary tumor and that, for some, no satisfactory procedure has been devised."⁹

Over the next quarter century, intracranial surgery flourished, and because of limited exposure and the risk of meningitis, the transsphenoidal procedure was abandoned by most neurosurgeons. Hirsch continued to use the transsphenoidal approach and, in 1956, reported his results in 413 cases.⁵ In the 93 patients treated after the introduction of antibiotics, morbidity dropped to less than two per cent. Other British, French, and Scandinavian surgeons^{10,11} adopted this procedure, and in 1961, Hamberger¹² outlined reasons for the returning popularity of the transsphenoidal approach: (1) decreased infection through the use of antibiotics; (2) improved exposure; (3) non-manipulation of optic nerves and chiasm; and (4) craniotomy and its inherent complications were avoided.

Svien¹⁰ investigated the transsphenoidal procedure for excessively enlarged sellas in patients who, in his hands, had done poorly after transfrontal craniotomy. He advocated a return to a more extensive lateral rhinotomy transmaxillary procedure to obtain greater exposure. His criteria for the transsphenoidal operation were: (1) excessively enlarged sella turcica with an aerated

sphenoid sinus, (2) absence of suprasellar extension, (3) a secreting pituitary tumor projecting into the sphenoid even without visual defects, and (4) cases in which a large frontal sinus complicated transfrontal craniotomy.

Intra-operative radiofluoroscopic monitoring was introduced by Guiot in 1958. Using fluoroscopic control and a direct midline approach, Hardy¹³ indicated the safety of the transsphenoidal removal of pituitary tumors with suprasellar extension and with only minor modifications, we have followed the surgical technique described by Hardy.

Surgical Technique

Frontal and lateral tomograms through the sphenoid sinus and sella turcica define the sellar floor and sphenoidal septa. Patients harboring intrasellar tumors require preoperative pneumoencephalography (with polytomography) and bilateral carotid angiography (Figure 1). In the presence of cerebrospinal rhinorrhea, RISA* cisternography provides crucial localizing information. During the 72 hours preceding operation, the nasal passages are prepared with nose drops made of bacitracin, 500 units per ml, and 0.25 percent phenylephrine hydrochloride (Neosynephrine®). Systemic administration of ampicillin is started 24 hours before operation and continued for five days thereafter.

The patient is placed in a semi-sitting position. After induction of general anesthesia and tracheal intubation, filtered air is introduced by the spinal route for visualization of the third ventricle if earlier studies had indicated suprasellar extension of the tumor. The head is rotated 45° to the right, extended slightly, and held in this position with three-point skull fixation or in a special foam headrest.

The fluoroscopic image intensifier is brought into the operative field and colimated to project a lateral image of the sella turcica on the television monitor. The lower face, nasal cavities, and mouth are cleansed with Phisohex® and benzalkonium chloride (Zephiran®-aqueous); the right lateral thigh is prepared with 1 percent tincture of iodine for possible muscle graft; and the operative field is draped, leaving exposed the nose, upper lip and thigh. The submucosa of the nasal floor and septum and the adjacent

*Radioactive iodinated human serum albumin.

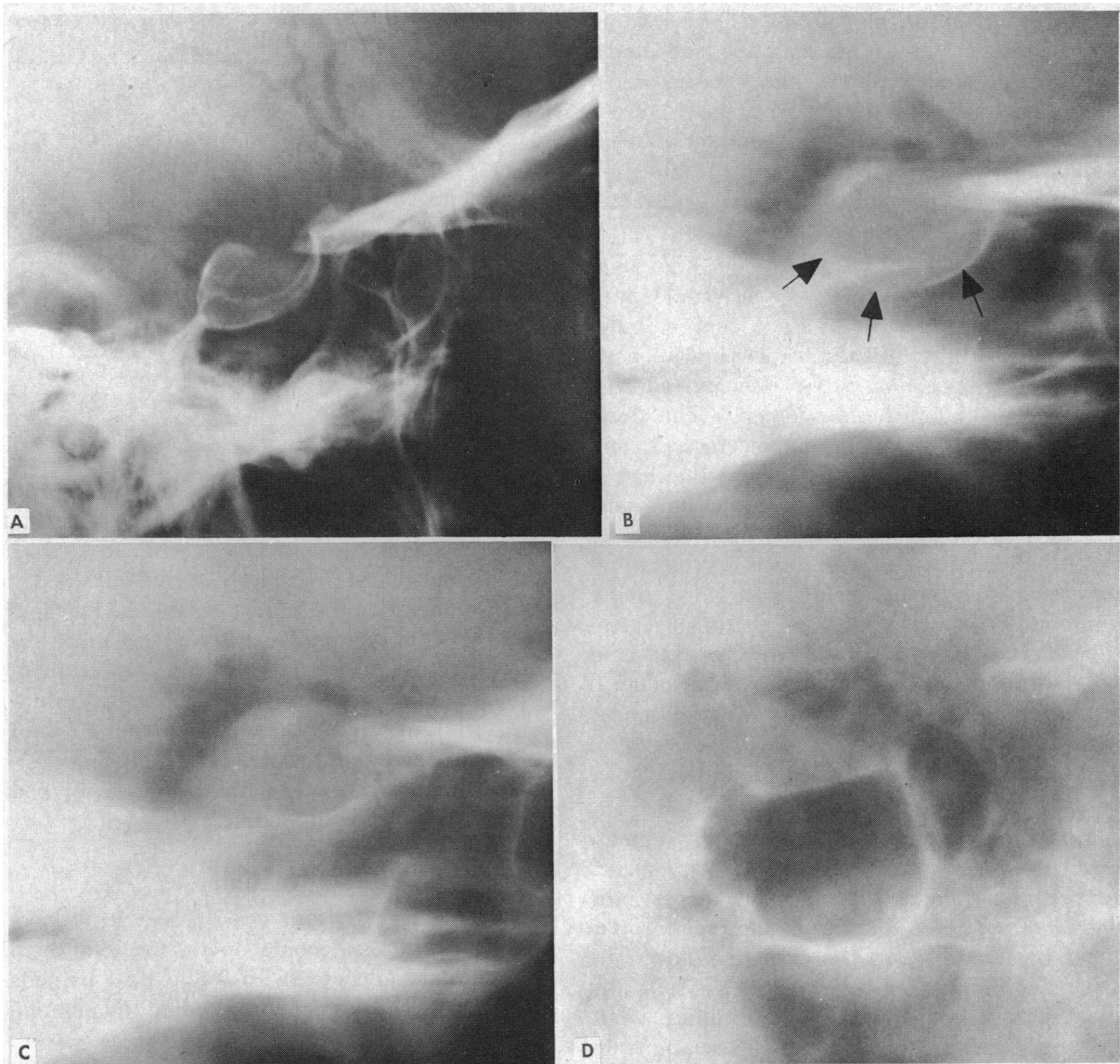


Figure 1.—Typical intrasellar hormone-secreting pituitary adenoma. *A.* Plain film, lateral view of the skull, illustrates the double floor of this sella turcica. *B.* Polytomographic cut, lateral projection to the right of midline, taken during pneumoencephalography shows the deepened right side of the sella with no suprasellar extension of the tumor. Note thinning of the cortical bone (arrows). *C.* Same as *B.* but to the left of midline. The sellar size is within normal limits and the cortical floor is normal. *D.* Polytomographic anteroposterior cut demonstrates the unilateral depression of the sellar floor produced by this right-sided pituitary adenoma.

labial gingiva are infiltrated generously with 0.5 percent xylocaine containing adrenalin 1:2000.

With the upper lip elevated, a transverse incision is made in the labial mucosa 5 mm from the gingival margin. The incision is deepened to expose the maxillary bone between the canine fossae. The upper lip is swept upward with sharp periosteal elevators to expose the piriform aperture, nasal spine, and lower edge of the nasal septum. The nasal spine and the projecting

rim of the maxilla are removed to widen and deepen the exposure, and the mucosa is carefully elevated from the nasal septum and floor. Submucosal introduction of a Hardy serrated bivalve speculum exposes the nasal septum and rostral projection of the sphenoid bone. The lower portion of the cartilaginous septum is excised and the vomer is disarticulated to expose the sphenoidal crest. The sphenoid sinus is entered with a high-speed air drill, using the angled Rand

handle designed for this purpose. The operating microscope is introduced and the sphenoidal window enlarged to expose the interior of the sphenoid sinus. Removal of the sinus mucosa and sphenoidal septa exposes the anterior sellar wall from the tuberculum sellae to its junction with the floor. The midline is established by reference to the maxillary nasal crest.

Large intrasellar tumors often reduce the sellar floor to mere flakes of thinned bone, while pituitary microadenomas may produce localized bulging and thinning of bone. Depending upon its texture, the presenting sellar bone is removed with the drill, punches or forceps. The dural lining is coagulated with bipolar forceps, and after needle aspiration of the tumor, the dura is opened with a cruciate incision. The intra-sella neoplasm is carefully removed with a variety of malleable spoons and pituitary ronguers, all intrasellar movements being performed under fluoroscopic control. Suprasellar tumor extensions tend to move downward into the excavated sella turcica and this migration can be followed by observing the air-filled third ventricle under closed television fluoroscopy. Any bleeding from within the sella is readily controlled by bipolar coagulation and gentle tamponade.

Pituitary microadenomas are clearly demarcated from the normal anterior pituitary gland. After removing adenomas of moderate size, the flattened yellowish pituitary gland can sometimes be identified on the dorsum sellae. The sellar diaphragm may collapse into the sella and care should be taken to leave it intact while holding it upward to visualize tumor remnants.

If cerebrospinal fluid (CSF) does not appear in the course of the operation, postoperative rhinorrhea is unlikely; a small amount of thrombin-soaked gelatin foam or Surgicel® is placed in the emptied sella. If CSF has entered the operative field, muscle with attached fascia lata is placed in the sella with the fascial surface against the diaphragm. The sellar floor is reconstituted with a piece of nasal septal cartilage. When the sella is massively enlarged, crushed fragments of vomer and maxilla are placed within the evacuated sella to prevent subsequent retraction of the diaphragm and adherent optic chiasm into the remaining cavity. The sphenoid sinus is irrigated with bacitracin, the speculum is withdrawn, and both nasal cavities are packed with vaseline gauze impregnated with bacitracin. The mucous

TABLE 1.—*Indications for Transsphenoidal Operation in 44 Patients*

Pituitary Adenoma	
Non-secreting	
1. visual failure	13
2. normal vision	5
Secreting	
1. somatotrophin	10
2. corticotrophin	4
3. prolactin	3
Craniopharyngioma	4
Cerebrospinal Rhinorrhea	2
Parasellar Aneurysm	3
Total	44

membrane may be closed with catgut sutures, although more recently we have learned that the mucosal edges reapproximate without sutures leaving an almost invisible scar.

After operation the patient is cautioned against nose blowing and sniffing. Nasal packs are removed on the third day. Should cerebrospinal rhinorrhea develop, it is treated by spinal drainage, acetazolamide (Diamox®), moderate fluid restriction and maintenance of a semi-erect position in bed. Ordinarily patients are out of bed on the day after operation.

Indications for Operation

During the past four years, 44 patients have undergone transsphenoidal operations, 35 of them for pituitary adenomas. In Table 1 all patients in this series are classified according to operative indication.

Pituitary Adenoma, Non-secreting

The patients in this group harbored non-secreting chromophobe adenomas, and all had one or more clinical expressions of hypopituitarism. Gonadotrophin deficiency, present in every patient, was expressed either as amenorrhea or as loss of libido.

Visual failure constituted the principal complaint and was the operative indication in 13 patients, the majority of whom had been treated earlier by irradiation, craniotomy alone, or craniotomy and postoperative irradiation.

An undiagnosed intrasellar mass with suprasellar involvement of the optic chiasm was the indication for operation in five cases. Preoperatively, four patients were believed to harbor

chromophobe adenomas, and one patient, because of extensive sellar erosion and a mass within the sphenoid sinus, was suspected of having a malignant tumor. After partial removal and identification of a chromophobe adenoma, all five patients underwent a course of postoperative irradiation (either Cobalt⁶⁰ or heavy particle).

Pituitary Adenoma, Secreting

Seventeen patients, all adults, had hormone-secreting pituitary adenomas. Clinical syndromes indicated hypersecretion of somatotrophin (growth hormone *STH*), corticotrophin (*ACTH*) and prolactin (mammotrophin, *PL*).

Ten patients had clinical features and laboratory evidence of acromegaly due to excessive *STH*. Two patients had undergone craniotomy followed by postoperative radiotherapy in the past, and both tumors extended above the sella turcica. One patient, previously untreated, had a large tumor that had deformed the optic chiasm without affecting vision. Because of suprasellar extension, this tumor was not suited for cryohypophysectomy, and transsphenoidal removal was selected rather than craniotomy. A fourth patient, an acromegalic, had a large mass within the sphenoid sinus and removal of the extrasellar component established the diagnosis of an eosinophilic adenoma. Following operation, the remaining tumor was treated by heavy particle irradiation. The remaining six patients presented with previously untreated clinically active acromegaly and an enlarged sella turcica. In two of these, craniotomy would have been difficult because of pathologically thickened frontal bones.

Four patients had *ACTH*-secreting pituitary adenomas. All four had been treated for Cushing's syndrome by bilateral adrenalectomy four to 15 years earlier. After adrenalectomy, these patients became hyperpigmented and had greatly elevated values for plasma *ACTH*. All were suspected of harboring *ACTH*-secreting pituitary adenomas (the post-adrenalectomy syndrome described by Nelson¹⁴), and serial skull films had been compared in order to detect the earliest indication of sellar enlargement. Up to the time of transsphenoidal operation, measurements of all four sellas remained within normal limits. However, in three instances retrospective examination of sequential films revealed an increase in the overall dimensions of the sella, and in all

other cases tomograms of the sella demonstrated asymmetric bulging of the anterior sellar floor. The slight sellar changes produced by small pituitary adenomas (microadenomas) will be the subject of a separate report.

One patient with Nelson's syndrome presented with pituitary apoplexy: sudden onset of headache, nuchal rigidity and involvement of all nerves passing through the right cavernous sinus caused by bleeding into the adenoma. Transsphenoidal removal of the hemorrhagic adenomas was done as an emergency procedure. The other three patients in this group underwent elective removal of microadenomas.

Three female patients sought medical attention because of galactorrhea and amenorrhea secondary to pituitary adenomas (Forbes-Albright syndrome). All three were presumed to be harboring prolactin-secreting adenomas, although this was confirmed preoperatively by serum *PL* levels in only one patient. In one patient the adenoma had invaded the orbit and cavernous sinus, and removal of the intrasellar component of an histologically benign adenoma was followed by irradiation. The other two patients harbored microadenomas, and transsphenoidal operation was undertaken on the basis of localized thinning and downward bulging of the anterior sellar floor in association with the endocrine abnormality.

Craniopharyngioma

Four children underwent transsphenoidal operation for craniopharyngiomas. One child had had multiple craniotomies and in the most recent procedure a large recurrent cyst had been drained through a stereotactically placed transsphenoidal opening in the intrasellar cyst wall. Six months later, the 4 mm opening closed and the cyst refilled. At that time the intrasellar cyst wall was exposed and a window 1.5 cm in diameter was made between it and the sphenoid sinus and nasopharynx. The second child was referred when intrasellar calcification was discovered during the course of an investigation for small stature. The sella was not enlarged and an air contrast study revealed only a 5 mm suprasellar nodule. A cystic craniopharyngioma was removed intact by the transsphenoidal approach. The third child was referred when skull films obtained for minor head trauma disclosed asymptomatic sellar enlargement although his

stature was small for his age. Tomography revealed no intrasellar calcification and, except for a minute nodule projecting beneath but not touching the optic chiasm, the tumor was confined to the expanded sella. Among craniopharyngiomas discovered in childhood, the frequency of radiographic calcification approaches 100 percent, and on this basis the preoperative diagnosis was pituitary adenoma. At operation, a soft, non-cystic tumor was removed, while sparing the uninvolved pituitary gland that was identified lying against the dorsum sellae. Microscopic examination of the tumor revealed an atypical papillary craniopharyngioma and the child is now receiving radiotherapy. The fourth patient, aged 16, was treated by craniotomy and twice thereafter with transsphenoidal drainage. His vision recovered to normal levels after each procedure.

Cerebrospinal Rhinorrhea

Two women were referred by neurosurgical colleagues when post-traumatic cerebrospinal rhinorrhea recurred after intracranial exploration. In each case the earlier craniotomy had not disclosed a definite fistula suspected in the cribiform plate of the ethmoid sinus. In both cases a fistula between the sella turcica and the sphenoid sinus was confirmed and closed by the transsphenoidal approach.

Parasellar Aneurysms

Three patients were referred because of progressive blindness secondary to giant parasellar aneurysms. Because of their size and configuration, these three aneurysms were unsuited for intracranial clipping and we elected to treat them by electrothrombosis, using a technique developed by one of us (Y.H.). A transsphenoidal approach to the tuberculum sellae allowed the construction of coordinates appropriate for introducing needles and wires into each aneurysm.

Complications (Table 2)

The only death occurred in a patient who suddenly died following an apparently uneventful recovery from electrothrombosis of a large parasellar aneurysm. Her death, due to pulmonary embolism, had no direct relationship to the transsphenoidal approach.

Six patients developed transient postoperative cerebrospinal rhinorrhea. The rhinorrhea ceased

TABLE 2.—Complications after Transsphenoidal Operations

Complications	
Postoperative rhinorrhea, transient	6
Postoperative rhinorrhea, requiring operation	1
Visual loss requiring reoperation	1*
Hematoma at muscle donor site	1
Deaths	1†

*Full recovery in 48 hours.

†Parasellar aneurysm; death unrelated to transsphenoidal procedure.

after one or more lumbar punctures, in three cases supplemented by Diamox® and moderate restriction of fluid intake. One child removed his nasal packing in the recovery room, and persisting rhinorrhea required insertion of a larger muscle pack four days later.

One patient, whose vision was impaired before operation, became blind eight hours after transsphenoidal removal of a partially cystic chromophobe adenoma. He was taken immediately to the operating room and the sella was quickly re-exposed. A large nodule of tumor attached to the tuberculum sellae had been missed at the original operation; postoperatively, because of infarction and hemorrhage related to surgical penetration, it had expanded to compress the optic chiasm. Vision returned to the preoperative pattern within 48 hours.

One patient required drainage of a hematoma that developed at the muscle donor site.

Results

Pituitary Tumors, Non-secreting

Among the 13 patients with impaired vision, only one (described above) had postoperative complication. All 13 left the hospital with vision either unchanged or improved. The vision of one or both eyes has improved in 11 patients, one patient has been lost to followup, and one was operated upon less than one month ago.

The five patients with normal vision had an uneventful recovery. Their tumors were subsequently irradiated.

Pituitary Tumors, Secreting

The ten acromegalic patients made satisfactory recovery although one developed a hematoma in the thigh. Clinical expressions of hypersomatotrophism have improved in six patients. This was confirmed in two patients by measurement

of serum somatotrophic hormone (STH), and the other patients reside in distant parts of the United States. Three patients have recently completed a course of heavy particle irradiation. Although three patients had suprasellar masses, none had impaired vision either before or after operation.

Depigmentation and a rapid fall in plasma ACTH values characterized the postoperative courses of three patients with Nelson's syndrome. The fourth patient, treated less than one month ago, has not undergone postoperative endocrine evaluation. Normal menstruation resumed in the one amenorrheic patient with a microadenoma. The significance of elevated ACTH persisting in three patients is unknown. The cavernous sinus syndrome has not resolved completely in the patient with pituitary apoplexy, but increasingly severe pain in the trigeminal distribution suggests neoplastic invasion of the trigeminal ganglion.

All three patients with the Forbes-Albright syndrome had immediate cessation of galactorrhea and early resumption of menstrual periods. The patient whose tumor had invaded extrasellar structures has completed a course of radiotherapy. Her partial oculomotor palsy and proptosis improved immediately after operation and almost completely resolved during radiotherapy. Postoperative irradiation was done in one patient with microadenoma and was not advised in the other patient because gross total removal of the adenoma was accomplished.

Craniopharyngioma

One patient who had undergone multiple surgical procedures and irradiation for a repeatedly recurrent cyst has remained symptom-free in the two years since a large window was created between the cyst and the sphenoid sinus. Successful drainage was also achieved in another patient by this technique.

The patient whose cystic intrasellar tumor was totally removed is doing well in school and engages in active sports. Complete panhypopituitarism requires replacement therapy, including growth hormone. The boy who harbored the atypical solid craniopharyngioma is receiving radiotherapy. We anticipate normal pituitary function, and the critical laboratory tests will be performed after he completes the course of irradiation.

Cerebrospinal Rhinorrhea

Both patients recovered rapidly following operative obliteration of sphenoid fistulas, and they have remained well for periods of three months and six months respectively.

Parasellar Aneurysms

A detailed account of the three patients undergoing transsphenoidal electrothrombosis will be included in a separate report. In the two surviving patients, aneurysmal thrombosis arrested visual deterioration, and in one of them vision has improved slightly.

Discussion

For the majority of non-secreting pituitary adenomas with suprasellar extension and optic chiasmal compression, the transsphenoidal approach provides an alternative to craniotomy. In the usual adenoma with smooth dome-like expansion out of an enlarged sella, transsphenoidal removal will achieve end results comparable to those obtained by craniotomy, but with the advantages of less risk and lower morbidity. We advise postoperative irradiation unless the tumor proves to be a cyst devoid of identifiable adenoma. When preoperative air contrast studies indicate either markedly eccentric extrasellar growth or waist-like constriction of the tumor where it extends through the sellar diaphragm, transsphenoidal removal is contraindicated.

The transsphenoidal approach appears to be the procedure of choice in the following situations:

- *The enlarged sella turcica discovered either incidentally or in the course of endocrine evaluation (for example, amenorrhea) or workup for headache.* After cerebral angiography and air contrast study have excluded an aneurysm, a suprasellar mass, hydrocephalus, and an "empty sella," in the past the majority of patients in this category have been referred for radiotherapy with the presumptive diagnosis of a non-functioning pituitary adenoma, and the rest have been followed without treatment.

We advocate transsphenoidal exploration for two reasons. First, the responsible lesion may be a non-neoplastic cyst or a largely cystic adenoma, both responding poorly or not at all to irradiation. Second, if the intrasellar mass proves to be a solid pituitary adenoma, operative removal fol-

lowed by irradiation offers a greater chance of cure than irradiation alone. This latter statement is based upon general experience with animal tumor systems in which the probability of radio-curability is inversely related to tumor size.

- *Pituitary tumors recurring after craniotomy or irradiation or both.* Following unsuccessful initial treatment, transsphenoidal removal offers an advantage over craniotomy, either primary or secondary. Many patients hesitate to submit to a second craniotomy, and the tumor recurring after (or unaffected by) irradiation is often cystic.

- *Intrasellar tumors with a major component occupying the sphenoid sinus.* Pituitary tumors that penetrate the sellar floor to invade the sphenoid sinus usually exhibit this pattern of growth because the sellar diaphragm is unyielding. These tumors are better managed from below than from above.

- *Pituitary apoplexy.* Sudden hemorrhage and infarction of a pituitary adenoma, occurring either spontaneously or during the course of irradiation, represents a medical and surgical emergency.¹⁵ Rapid expansion of the mass characteristically causes visual loss, impairment of cranial nerves in the cavernous sinus, acute hypopituitarism manifested by adrenal insufficiency, and subarachnoid hemorrhage. After correcting life-threatening metabolic derangements, the surgeon must relieve pressure on the critical structures. The speed and associated low morbidity of transsphenoidal decompression favor this approach in these typically ill patients.

- *Failing vision in elderly and debilitated patients.* Because the transsphenoidal approach involves a shorter period of general anesthesia and avoids certain hazards inherent to craniotomy, it can be advised for patients who are poor surgical risks. In this circumstance, an operation with a limited objective—decompression of the optic chiasm—can be performed by the transsphenoidal approach in view of the procedure's speed and low morbidity.

Still undefined is the role of transsphenoidal removal in the treatment of functioning pituitary adenomas. For the *STH*-producing adenoma associated with gigantism and acromegaly, the primary treatment of choice has been either heavy particle irradiation or stereotaxic cryohypophysectomy. Transsphenoidal removal provides an alternative to craniotomy in the management of tumors with symmetrical suprasellar extension

and tumors recurring after irradiation and cryosurgery.

The recent surgical verification of hormone-secreting pituitary microadenomas introduces a new concept into clinical endocrinology. Some functioning microadenomas eventually erode the sella and produce signs of an enlarging intrasellar tumor. Other microadenomas may continue to secrete their hormonal product for extended periods of time. Using polytomography, we have identified subtle sellar changes produced by tumors less than 1 cm in diameter. To date, we have not removed a microadenoma from a sella that lacked some structural abnormality.

ACTH-secreting microadenomas may prove to be a common cause of Cushing's syndrome; Hardy has removed such a microadenoma.¹¹ Present evidence strongly suggests that a microadenoma underlies Nelson's syndrome, and it is reasonable to assume that the microadenoma existed before adrenalectomy.

Our experience indicates that prolactin-secreting microadenomas can produce galactorrhea and amenorrhea (Forbes-Albright syndrome).¹⁶ Del Castillo described amenorrhea and galactorrhea in nulliparous non-gravidas without apparent cause (Agroncz-del Castillo syndrome). These same symptoms occurring in association with sellar enlargement (presumptive evidence of a pituitary tumor) constitute the Forbes-Albright syndrome, the obvious differentiating feature being the absence or presence of a *recognized* pituitary tumor. We suggest that a significant number of patients carrying the diagnosis of Agroncz-del Castillo syndrome may harbor microadenomas. Hardy¹¹ has removed a microadenoma from a patient with thyrotoxic exophthalmus and a high level of long-acting thyroid factor. Other endocrinopathies may have a similar basis.

Our experience with microadenomas supports the observations of Hardy.¹⁵ He found that microadenomas occupy the rostral surface of the anterior pituitary gland and consequently lie superficially against the anterior sellar floor. He further observed that microadenomas have a sharp line of demarcation from the normal gland. If this anatomical arrangement proves to be a consistent finding, microadenomas are ideally suited to operative removal by the transnasal-transsphenoidal approach with the decided advantage of protecting and sparing the normal pituitary gland and its hypothalamic connections.

The transsphenoidal approach offers an alternative to intracranial removal of strictly intrasellar craniopharyngiomas. If the intrasellar tumor adjoins a well-pneumatized sphenoid sinus and if preoperative air contrast study indicates short optic nerves, the transsphenoidal operation has advantages over craniotomy. The transsphenoidal approach also provides a safe and simple means of draining cystic craniopharyngiomas. If a part of the cyst wall lies within the sella, permanent drainage can be established by creating a large opening between the cyst and the sphenoid sinus.

Cerebrospinal rhinorrhea seldom originates from a congenital fistulous opening into the sphenoid sinus, and excepting those that occur with pituitary tumors, the majority of fistulas follow trauma. After diagnostic procedures have established the presence of a sphenoid fistula, transsphenoidal repair is the procedure of choice.

In a growing experience with electrothrombolysis, the utilization of several different surgical approaches has increased our ability to deal with a variety of intracranial aneurysms. The transsphenoidal exposure of large parasellar aneurysms has two principal advantages: first, wires and needles can be introduced into the aneurysm without the deep retraction required during intracranial exposure; and secondly, the transsphenoidal

approach is well-tolerated even by seriously ill patients. Our favorable experience with the three cases herein reported encourages its future use.

REFERENCES

1. Halstead AE: Remarks on the operative treatment of tumors of the hypophysis. *Surg Gynecol & Obstet* 10:494, 1910
2. Kanavel AB: The removal of tumors of the pituitary body by an intranasal route. *JAMA* 53:1704, 1909
3. West JM: The surgery of the hypophysis from the standpoint of the rhinologist. *JAMA* 54:1132, 1910
4. Hirsch O: Endonasal method of removal of hypophyseal tumors. *JAMA* 55:772, 1910
5. Hirsch O: Pituitary tumors—A borderland between cranial and trans-sphenoidal surgery. *N Engl J Med* 254:937, 1956
6. Hirsch O: A patient with a pituitary tumor operated on by the cranial method, re-operated four years later for recurrence by the trans-sphenoidal method and followed for 37 years. *Confin Neurol* 19:398, 1959
7. Hirsch O: Life-long cures and improvements after transsphenoidal operation of pituitary tumors. *Acta Ophthal Suppl* 56:1-60, 1959
8. Cushing H: Surgical experiences with pituitary disorders. *JAMA* 63:1515, 1914
9. Hamlin H: The case for transsphenoidal approach to hypophyseal tumors. *J Neurosurg* 19:1000, 1962
10. Svien HJ, Litzow TJ: Removal of certain hypophyseal tumors by the transantral-sphenoid route. *J Neurosurg* 23:603, 1965
11. Hardy J: Transsphenoidal microsurgery of the normal-pathological pituitary. *Clin Neurosurg* 16:185, 1969
12. Hamberger CA, et al: Transantrosphenoidal hypophysectomy. *Arch Otolaryn* 74:2, 1961
13. Hardy J, Wigser S: Transsphenoidal surgery of pituitary fossa tumors with televised radiofluoroscopic control. *J Neurosurg* 23:612, 1965
14. Nelson DH, Meakin JW, Thorn GW: ACTH-producing pituitary tumors following adrenalectomy for Cushing's syndrome. *Ann Int Med* 52:560, 1960
15. Locke S, Tyler HR: Pituitary apoplexy—Report of two cases, with pathological verification. *Am J Med* 30:643, 1961
16. Buckman MT: Galactorrhea—A clinical approach. *Rocky Mt Med J* 68:27, 1959

ALCOHOL TO DISINFECT THE HANDS

Can you really disinfect hands with alcohol?

I know from skin studies by the thousands that the application of a little acidified alcohol will remove all the surface bacteria by the time it evaporates from the hands. It is the single most effective way of disinfecting hands. I can provide a ton of data to prove this point. If you add some hexachlorophene, it's even more effective. . . . Isopropyl alcohol or ethyl alcohol (70 percent) are enormously effective. They're kind to the skin and they do stop the digital and manual transmission of contamination much better, much more effectively than what we call handwashing.

What about drying the hands afterward?

I like to see the user just let the alcohol evaporate, which it does very quickly.

—CARL W. WALTER, M.D., Boston
Extracted from *Audio-Digest Surgery*, Vol. 17, No. 9, in the Audio-Digest Foundation's subscription series of tape-recorded programs. For subscription information: 1930 Wilshire Blvd., Suite 700, Los Angeles, Ca. 90057